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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/357,264	07/19/1999	FAN ZHANG	30-4790(4780	9000
23639	7590	06/14/2005	EXAMINER	
BINGHAM, MCCUTCHEN LLP THREE EMBARCADERO CENTER 18 FLOOR SAN FRANCISCO, CA 94111-4067			SONG, MATTHEW J	
			ART UNIT	PAPER NUMBER
			1722	

DATE MAILED: 06/14/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/357,264

Applicant(s)

ZHANG ET AL.

Examiner

Matthew J. Song

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 21 March 2005.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 19-43 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 19-43 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- ☐ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. Claims 29-33 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 29 recites, “the method of claim 19, wherein the slurry solution comprises H₂O₂”. As claimed, claim 19 requires a slurry solution comprising at least two components and claims 19-33 limit the slurry solution to a single component, which renders the claims indefinite.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 19 and 29-33 are rejected under 35 U.S.C. 102(e) as being anticipated by Kaufman et al (US 5,954,997).

Kaufman et al discloses a single chemical mechanical polishing (CMP) slurry to polish metal layers, particularly copper or copper alloy containing layers in an integrated circuit (col 4, ln 1-10) and the term copper alloy includes substrates comprising Ta/TaN/Cu multi-layer substrates (col 5, ln 1-15), this reads on applicants’ single slurry solution that includes a Cu/Ta/TaN surface. Kaufman et al also discloses a preferred oxidizer used in the CMP slurry is

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hydrogen peroxide and compounds which upon reduction from hydroxyl radicals (col 5, ln 25-45), this reads on applicants' oxidizing reactant. Kaufman et al also discloses other well known polishing slurry additives may be incorporated into the slurry, such as sulfuric acid, phosphoric acid, nitric acid, oxalic acid, acetic acid to enhance the polishing rate of the barrier layers in the wafer, such as tantalum (col 6, ln 1-35), this reads on applicants' co-reactants.

Referring to claim 19, Kaufman et al discloses the single step slurry solution including a combination of peroxide with phosphoric acid, HF acid, sulfuric acid, nitric acid, oxalic acid or acetic acid (col 4, ln 5-10, col 5, ln 25-45 and col 6, ln 1-35). Kaufman et al also discloses the CMP slurry is applied to the substrate and at least a portion of the metal layer is removed (col 4, ln 30-35). Kaufman et al also discloses the CMP slurry polishes copper, tantalum and tantalum nitride layers at good rates under controllable conditions, this reads on applicants' planarizing both the Cu and at least one of the Ta and TaN during a single processing step (col 9, ln 5-20; col 8, ln 35-45; and col 6, ln 20-35).

Referring to claims 29-33, Kaufman et al discloses peroxide, phosphoric acid, sulfuric acid, nitric acid and acetic acid.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5. Claims 19-23, 28-35 and 39-43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kaufman et al (US 5,954,997) in view of Applicants Admitted Prior Art (Admission).

Kaufman et al teaches all of the limitations of claim 28, as discussed previously, except the step of planarizing removes the Cu and at least one of the Ta and TaN with approximately 1:1 selectivity. Admission teaches Cu/Ta/TaN CMP requires slurries with high Cu and Ta/TaN removal rates and close to a 1:1 removal selectivity between Cu and a liner metal of Ta or TaN (pg 6).

Kaufman et al teaches optional additives may be added to the polishing slurry to further improve the polishing rate of the barrier layers in the wafer, such as tantalum (col 6, ln 20-35). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Kaufman et al by optimizing the polishing slurry by using selecting additional additives to obtain a 1:1 removal selectivity between Cu and a liner metal, which is desirable, as evidenced by Admission.

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6. Claims 36-38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kaufman et al (US 5,954,997) in view of Applicants Admitted Prior Art (Admission) as applied to claims 1, 12, 16-23, 27, 28-35 and 39-43 above, and further in view of Hampden-Smith et al (US 6,602,439).

The combination of Kaufman et al and Admission teaches all of the limitations of claim 13, as discussed previously, except the combination of Kaufman et al and Admission does not teach the abrasive particles are coated.

In a method of chemical mechanical planarization, note entire reference, Hampden-Smith et al teaches abrasive particles comprises SiO_2 with a CeO_2 coating. Hampden-Smith et al also teaches such coatings can advantageously provide accurate control over the particle density and can also provide control over the chemical and mechanical action of the particles during polishing (col 38, ln 1-25). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Kaufman et al and Admission by using the SiO_2 particles coated with CeO_2 to improve control over particle density and control of the chemical and mechanical action of the particles during polishing.

7. Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kaufman et al (US 5,954,997) or Kaufman et al (US 5,954,997) in view of Applicants Admitted Prior Art (Admission) as applied to claim 19 above, and further in view of Pozniak et al (US 5,887,974) or Avanzino et al (US 5,916,855).

Kaufman et al or the combination of Kaufman et al and Admission teaches all of the limitations of claim 24, as discussed previously, except the slurry solution further includes at least one of CuCl , FeCl and FeCl_3 .

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In a method of preparing a slurry, Pozniak et al teaches slurries are typically used in chemical mechanical polishing or planarization (CMP) and the slurries comprise potassium hydroxide, silicon oxide, an oxidizer such as hydrogen peroxide, may also contain ferric nitrate or chloride (col 1, ln 10-25). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Kaufman et al or the combination of Kaufman et al and Admission by using ferric chloride because it is conventional used in CMP slurries.

In a method of chemical mechanical polishing, Avanzino et al teaches the addition of ammonium chloride is desirable to stabilize the slurry of ferric nitrate and persulfate and FeCl_3 could be used in place of ammonium chloride (col 12, ln 35-65). Kaufman et al teaches a variety of CMP slurry additives, such as stabilizers may be used (col 6, ln 35-45). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Kaufman et al or the combination of Kaufman et al and Admission by using FeCl_3 to stabilize the slurry.

8. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kaufman et al (US 5,954,997) or Kaufman et al (US 5,954,997) in view of Applicants Admitted Prior Art (Admission) as applied to claim 19 above, and further in view of Cronin et al (US 6,143,640) or Carpio (US 5,846,398).

Kaufman et al or the combination of Kaufman et al and Admission teaches all of the limitations of claim 25, as discussed previously, except the slurry solution further includes at least one of $\text{Cu}(\text{NO}_3)_2$, CuSO_4 , EDTA, FeNO_3 , KOH, $\text{K}_2\text{S}_2\text{O}_5$, $(\text{NH}_4)_2\text{S}_2\text{O}_8$, CuNH_4Cl_3 , NaOH, NaClO_3 , NaNO_3 , $\text{Na}_2\text{S}_2\text{O}_8$, NH_4F or NH_4OH .

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In a method of planarizing a copper layer, Cronin et al teaches chemical mechanical polishing of a copper layer utilizing an ammonium persulfate/potassium hydroxide slurry (col 6, ln 5-25).

Kaufman et al teaches other well known polishing slurry additives may be incorporated, such as potassium salts (col 6, ln 20-35). Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Kaufman et al or the combination of Kaufman et al and Admission by using potassium hydroxide, as taught by Cronin et al, as an additive to the copper planarization.

Carpio teaches a CMP slurry for copper metal layers comprising at least one oxidant capable of forming a passive oxide, such as ferric nitrate, ammonium peroxydisulfate, alkali or metal peroxydisulfate salts, iodates, bromates or chlorates (col 4, ln 30-60). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Kaufman et al or the combination of Kaufman et al and Admission by using the oxidizer taught by Carpio because substitution of known equivalents for the same purpose is held to be obvious (MPEP 2144.06).

9. Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kaufman et al (US 5,954,997) or Kaufman et al (US 5,954,997) in view of Applicants Admitted Prior Art (Admission) as applied to claim 19 above, and further in view of Ohmori et al (US 5,639,363).

Kaufman et al or the combination of Kaufman et al and Admission teaches all of the limitations of claim 26, as discussed previously, except the slurry solution further includes at least one of a molybdenum salt and phenosulfonic acid.

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In a method of mechano-chemical polishing, Ohmori et al teaches an inorganic salt is an alkaline metal salt of one of carbonate, silicate, and molybdate and contains cations of molybdenum, sodium or potassium. Ohmuri et al also teaches it is preferable that the anion comprise at least one of chlorine ion, nitrate ion, or sulfate ion (col 4, ln 10-30).

Kaufman et al teaches slurry additives may be incorporated, such as cationic salts of sulfates, phosphates and fluorides (col 6, ln 20-35). Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Kaufman et al or the combination of Kaufman et al and Admission by using the cationic salt taught by Ohmuri et al to produce an expected result.

Response to Arguments

10. Applicant's arguments filed 3/21/2005 have been fully considered but they are not persuasive.

Applicant's arguments regarding claim 19 are noted but are not found persuasive. Applicant's allege that there is no indication that there is a high Cu:Ta selectivity. However, claim 19 does not require a high selectivity. Claim 19 merely requires a single step slurry solution, applying the solution to a substrate and planarizing Cu and Ta or Tan, which is taught by Kaufman et al ('997). Applicant's also argue that reference '306 teaches it is difficult to remove Cu and Ta using a single slurry, which suggest a high selectivity can be achieved. However, a high selectivity is not claimed; therefore the argument is not relevant to the claimed invention.

In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., providing a

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single step slurry solution that has a high Cu:Ta selectivity (pg 8)) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993). There is no mention in claim 19 in regards to selectivity.

In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., providing a single step slurry solution that has a high Cu:Ta selectivity (pg 10)) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993). Claim 34 merely requires a 1:1 removal selectivity, which is not a high selectivity.

Applicant's argument regarding claim 34 are noted but are not found persuasive. Applicant's allegation that there is no indication that there is a high Cu:Ta selectivity and reference '306 supports this position is noted. However, a high selectivity is not claim and reference '306 also teaches a CMP slurry has a copper to tantalum polishing selectivity of less than about 2 to 1 and most preferably less than about 1 to 5 ('306 col 7, ln 20-30) and the range of polishing selectivity overlaps the claimed range of 1:1. Furthermore, applicants have cited the prior art portion of reference '306, which merely teaches the state of the art previously, and reference '306 also teaches there is a need for one or more CMP slurries that can be used successfully to polish copper and tantalum containing substrates (col 3, ln 10-20). A high selectivity is not claimed and the claimed selectivity can be determined through routine optimization. It also noted that '997 teaches a similar slurry composition to the claimed slurry

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composition and the polishing slurry has been found to have a high copper, titanium, titanium nitride and tantalum nitrate and acceptable tantalum polish rates (col 8, ln 35-45), which contradicts applicant's assertion that '997 only teaches "acceptable rate".

Conclusion

11. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Ueda et al (US 5,697,992) teaches cerium oxide may be adhered to or coated on the surface of an abrasive particle to improve the polishing rate without causing scratches and orange peels (col 3, ln 20-35).

Small et al (US 2002/0111024) teaches a composition of a polishing slurry using oxidizer for copper and tantalum and using nitric, sulfuric and citric acid ([0048],[0032]).

Zhang et al (US 6,630,433) claims similar subject matter and was filed after the instant application.

Zhang et al (US 2002/0020833) claims similar subject matter and was filed on the same day as the instant application.

12. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO**

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MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J. Song whose telephone number is 571-272-1468. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Duane Smith can be reached on 571-272-1166. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

MJS

Matthew J Song
Examiner
Art Unit 1722



ROBERT KUNEMUND
PRIMARY EXAMINER